THE

JOHNSON SYSTEM

OF

HEAT REGULATION.

BY WM. F. CHESTER.

A PAPER READ BEFORE THE SOCIETY OF ARTS AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
MARCH 22, 1888.

BOSTON:
THE NATIONAL ELECTRIC SERVICE CO.
150 ~~178~~ DEVONSHIRE STREET.
72 Equitable Bldg.

THE JOHNSON SYSTEM OF HEAT REGULATION.

A PAPER READ BEEORE THE SOCIETY OF ARTS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, MARCH 22, 1888.

BY WILLIAM F. CHESTER.

It will be needless to give any statistics relating to the various stages which have led to the successful development of the system. or to describe any attempts which have been made by us or others to partially accomplish the general result. I will, in the limited amount of time at my disposal, merely describe it in its present perfect state.

The objects primarily sought for by the inventor were health and comfort; but experience has developed the fact that from twenty to forty per cent is saved in fuel, according to the heat generator or supply used. Damage to furniture, woodwork and frescoing from overheating is also prevented, as well as wear and tear on valves, etc.

We can all probably testify to the discomfort of having the temperature gradually rise in a room until we have become almost dizzy, then to discover that the thermometer indicated 80 degrees or more, then the rush to open the windows, only probably to cool off the room too suddenly.

The system which I hope to explain is intended to prevent such experiences by regulating the heat supplies for any purpose, and maintaining, as far as the sensations are concerned, a perfectly uniform temperature, *i. e.*, within one degree if necessary. As soon as the thermometer indicates 70 degrees (if that is the desired temperature), the supply of heat is automatically cut off, and remains cut off until the thermometer falls to 68 degrees, at which point the heat is turned on again. This can be done without regard to the outside temperature.

It is not necessary or desirable ever to touch a register, damper, steam valve or other regulator when this system is used. An attachment, however, is furnished to vary the temperature at will.

While electricity is extremely necessary to this system, it is called upon to furnish an infinitely small amount of power for a minimum length of time, which, I believe, accounts for the reliability of the system and the long life of the battery used. In order that you will not misunderstand me to imply that electricity is unreliable, I will explain that where batteries (particularly those which belong to the open circuit class) are given heavy work to do, or are used too continuously for even light work, they vary in strength, and in many cases are permanently weakened.

The owners of this system at first took out patents to perform the work of operating registers, dampers, valves, etc., by means of electro-magnets applied directly to those heat supplies: but for the reasons just stated, they abandoned the use of electricity as a motive power and substituted gas, vapor, liquids, etc.

Compressed air has proved the most satisfactory and, at present, is used almost exclusively.

In describing the details we will divide the apparatus into two departments, viz: 1st, The Electrical or controlling portion. 2d, The Pneumatic or working portion.

The electric circuit comprises the thermostat, the battery and portions of the electro-pneumatic valve.

The thermostat used is composed of two strips of brass and hard rubber respectively riveted together. The hard rubber being about eight times as sensitive to changes of temperature as brass, it cannot expand or contract uniformly, being restrained on one side by the brass. The result is that the thermostat or compound strip will bend to the right or left, forming an arc or bow, as the temperature rises or falls. Attached to the end of the strip is a light tongue of metal provided with platinum

contact points on either side. As the end of the compound strip bends to the right or left in response to the changes of temperature, the attached metallic tongue will touch one or another of two contact points provided for it and complete an electric circuit, which, by means of the battery will operate the electro-pneumatic valve, the latter setting in motion the power which operates the heat supplies. The thermostat is provided with a scaled adjustment by which the temperature can be varied. For instance, in a dwelling it is generally desired to keep the temperature lower at night than during the day.

The battery is generally from two to four Leclanche cells, a slight impulse from which being being sufficient to control the power to start or stop a Corliss engine.

The electro-pneumatic valve is composed first of two magnets, one to attract the armature in one direction and the other to draw it back again. The armature is pivoted at the centre, with the magnet poles at the swinging ends ; it is placed in an air-tight chamber and performs two functions in response to each impulse of electricity, namely: It first breaks the electrical circuit on one side as soon as it moves, and completes it on the other ready for the thermostat to throw it in the opposite direction, allowing the battery to be closed only for the shortest amount of time required to move the armature. The second function is to control the supply of compressed air which flows through the air tight chamber referred. to .

The pneumatic portion includes the air pump, the tank in which is stored the air under pressure of ten ponds, the air-tight chamber of the electro-pneumatic valve, the various diaphram valves at the heat supplies and the piping which connect the parts just enumerated.

The pump and tank need no description. The pneumatic chamber of the electro-pneumatic valve has three openings, all controlled by the magnet armature within the chamber. The first leads to the air supply or tank, the second to the diaphram valves at the heat supplies, and the third is an escape for the air when the pressure is removed at the diaphragms.

The valves at the heat supplies are operated by rubber or metallic dia phragms, strengthened by wooden saucers and propelled by the compressed air which is controlled by the electro-pneumatic valve. When the compressed air is applied to a diaphragm, it closes the steam valve, damper or register, shutting off the heat. When the pressure is removed, the air escapes through the third opening in the air-tight cham-

ber of the electro-pneumatic valve, allowing the diaphragm to return to its original and normal position, assisted by metallic springs provided for the purpose.

In case steam is used, three very desirable results are attained; 1st, Both valves connected to a radiator are operated simultaneously, rendering it impossible to cut off one without the other, and the valves are left either fully opened or closed. 2d. The stem of a valve does not turn, but moves with a piston like motion, thus saving grinding at the seat, which occurs when the valve is turned by hand. The packing, for the same reason, will last longer. 3d. When the valves have cut off the supply of steam, no leakage can take place through them, when the metal cools off, because the pressure of the diaphragms will keep the valves tightly closed.

In apartments, office buildings, school houses, hospitals, and all other large buildings, as well as residences, where some rooms are more exposed than others, this system will distribute the heat uniformly and economically. The warmer rooms will not be allowed to become overheated, but the supply will be cut off at the proper temperature, throwing an increased supply into the colder rooms which need it more. Finally, when the last room is warm enough, application is automatically made to the furnace or boiler, shutting off the fire draft and opening the furnace door, thus saving heat and fuel. When any room cools down two degrees the drafts at the furnace are restored.

Another feature in connection with large buildings in which a number of people are congregated who must have a constant supply of fresh air is this: The supply of air is not interfered with, but its temperature is modified. In residences and offices the problem is always more simple.

In 1886 a plant was placed in two rooms of the Joshua Bates School, Boston, and the temperature maintained within two degrees, or about 69 degrees. The other rooms of the school not supplied with the system varied from 67 degrees to 82 degrees, or 15 degrees, the pressure at the boiler varying in each case from six to ten pounds. These facts were obtained from a copy of the "Sanitary Engineer" dated May 6th, 1886.

The Council Chamber, City Hall, Boston, has been supplied with this system for three seasons. I am informed by the officials in charge that the temperature has not varied more than two degrees during the time that artificial heat has been used, and that the apparatus has worked

perfectly. I mention the above facts to show what has been done, rather than to state what may be.

While I have alluded more particularly to the system as applied to residences and buildings to maintain healthy temperatures (which comprises a large proportion of the work done), there is no limit to the uses to which it may not be put. To illustrate:

Lorillards tobacco factory in Jersey City maintains a temperature of 160 degrees in its drying rooms.

The American Bank Note Company, New York, while regulating its heat in the winter, uses ice water in the same pipes during the warm weather to modify the temperature.

Several trains on the Chicago, Milwaukee & St. Paul Railroad, are controlled as far as heat is concerned, as follows: various drafts and doors on each Baker-heater, and four ventilators in each car are operated, by one impulse of electricity regulated by the Johnson Thermostat.

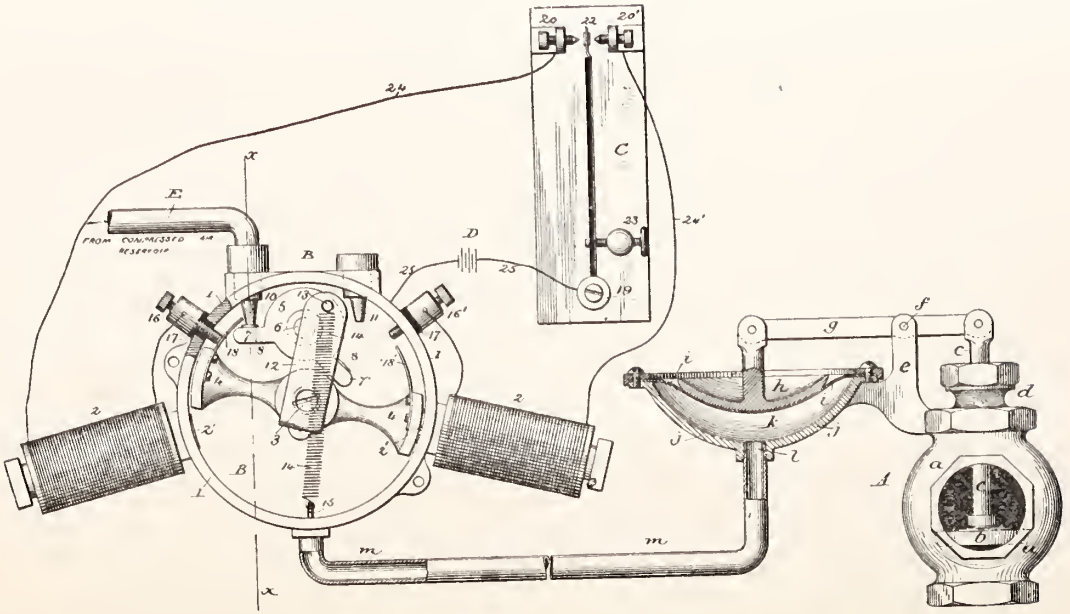
Turkish baths, factories, churches, theatres (notably the Madison Square, New York), colleges, conservatories, kilns, ice machines and steam whistles have had the system applied successfully.

The new Broadway Theatre, New York, while not using the system to regulate heat, has applied the motive power to open simultaneously thirteen emergency exit doors in case of panic from fire or other cause.

In a town in Dakota, whose water supply for fire purposes is located on a hill three-quraters of a mile distant, it is not desirable to subject the pipes to the high pressure, except when actually needed. It was formerly the custom to send a man to the hill to turn on the supply when a fire occurred. It is now controlled by a diaphragm valve on the hill, which is actuated by a press-button, in town, saving valuable time and probably property.

Application has been made by several passenger elevator companies for right to use the pneumatic system to control the movement of elevators by push-buttons and diaphragm valves, to supersede the wire ropes now used.

At the risk of being criticised, perhaps, for illustrating by examples, as above, I have preferred, as I stated before, to furnish facts rather than to boast of possibilities, and I trust that you will appreciate my motives in so doing.



JOHNSON'S SYSTEM OF HEAT REGULATION.

The very fine illustration which we here present shows the thermostat electro-magnetic device and a steam valve in operation so plainly that no detailed description is necessary. A is the valve to be operated upon; C is the thermostat which makes at a remote point the electrical circuit which operates the electrically actuated secondary valve, B controlling the air under pressure operating on the valve A. The battery employed is represented at D. A pipe E leads from some convenient source of compressed air which is controlled by the valve B in such a manner that it will operate the valve A.

The various forms of this most excellent system are in working order at the Company's office. All persons interested in a matter which so closely affects health and comfort, and which, at the same time, is so economical in every respect, are respectfully invited to inspect it. Undoubted assurances of its *perfect* service will be given, from customers of several years standing.

THE NATIONAL ELECTRIC SERVICE CO.

ROOM ~~88~~. 72 150 ~~178~~ Devonshire Street.